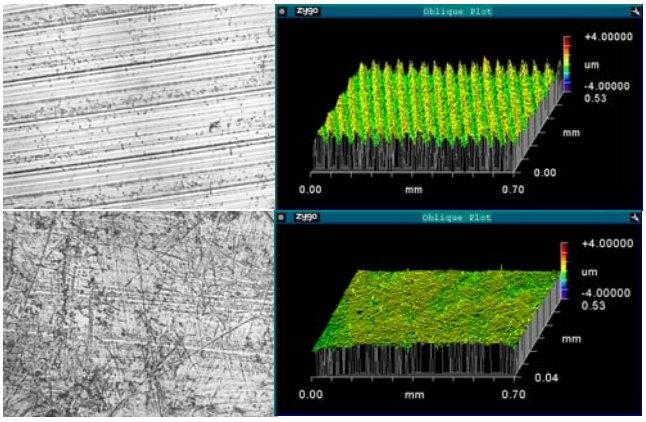
Evaluation of Functional Characteristics of Precision Finished Surfaces

Dalong Gao, advisor: Shreyes Melkote

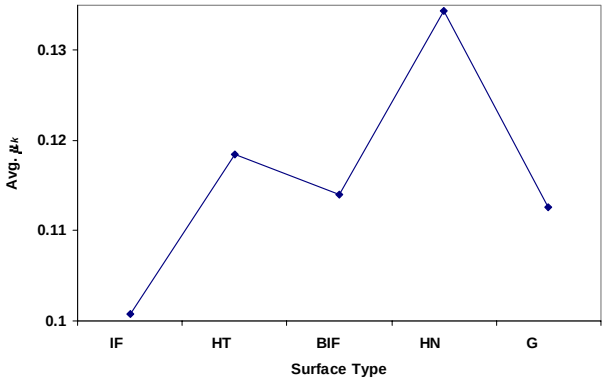
In-service functional performance of a component is closely tied to the geometric and mechanical properties of the surface produced by the finishing process used to make the component. In particular, tribological performance characteristics (e.g. friction, wear, lubrication) of load-carrying surfaces, such as in bearings, are known to be influenced by the texture produced in the surface finishing process employed. For instance, the run-in behavior of bearing surfaces produced by different surface finishing processes has been shown to be influenced by the presence and directionality of the lay pattern on the surface. In addition to texture, mechanical and metallurgical properties of the finished surface layers also play an important role in determining the component tribological behavior. Since different finishing processes result in different surface textures and associated properties, it is of interest to develop a fundamental understanding of the relationship between different surface textures and their functional properties such as friction, wear, and lubrication under different contact conditions. In particular, surface functional behavior in rolling and/or sliding contact is of interest to the bearing industry. This understanding and knowledge will be beneficial to new process development and optimization efforts in the bearing industry.



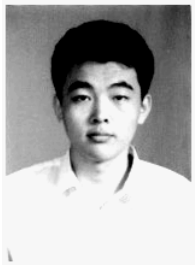
Representative pictures of the different surface types obtained by optical microscopy and a Zygo 3-D surface scanning instrument, uppers are from hard turned surface, lowers are from isotropic finished surface.

The first phase of the work involved an experimental investigation into the effect of surface texture generated by different surface finishing processes (grinding, hard turning, honing, isotropic finishing, and black isotropic finishing) on the static and kinetic coefficient of sliding friction between a planar precision finished surface and a spherical counter-surface (simulating a point contact between a ball and bearing surface).
A numerical model of partial elastohydrodynamic lubrication for rough surfaces is under developing to simulate the real conditions in tests.

Further tests for rolling/sliding contact will be performed after developing a precision test rig capable of a reasonably wide range of contact loads and rolling/sliding velocities.



Plot showing the main effect of different surface finishing for the kinetic friction coefficient (from statistic analysis)



Dalong Gao is a Ph.D. Candidate in precision machining research center. He received his BSME and BSIE degrees from Tsinghua University in 1999 and started graduate studies at Georgia Tech in the fall of 2000. He plans to graduate with a Ph.D. in mechanical engineering by May 2004.

For more information, please contact Dalong Gao directly at: gte655w@prism.gatech.edu

To learn more about other research at Georgia Tech, please contact Scott Billington at:
scott.billington@marc.gatech.edu
Georgia Institute of Technology
Manufacturing Research Center
Phone: 404-385-0895